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Resin Optical Element and Manufacture of the Same

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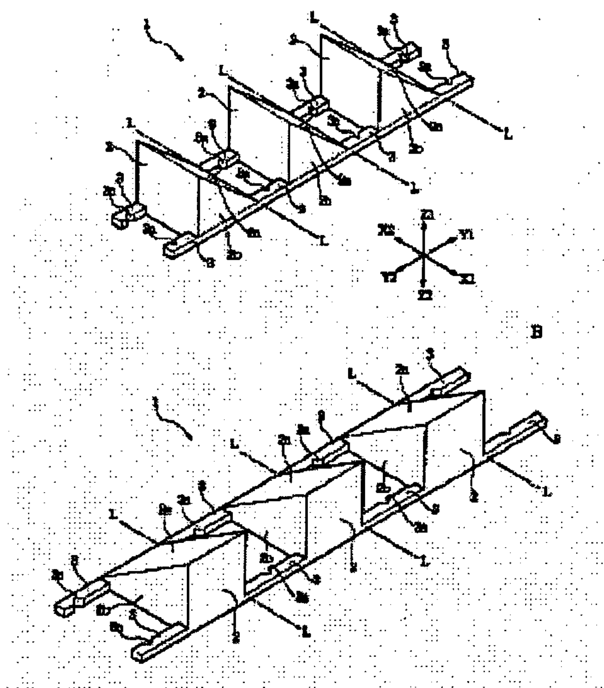
(54) [Title of the Invention] Resin Optical Element and Manufacture of the Same

(57) [Summary] (revised)

[Problem] In the past, optical elements have been formed individually by a means such as injection molding, and because many of them are often small in size, handling the elements has been difficult during subsequent vapor deposition carried out so as to produce mirrored or polarizing surfaces, or during operations that involve analysis, mounting and packaging.

Fig. 1



[Means] A plurality of optical elements **2, 2, 2**, . . . are formed as an assembly of optical elements that are linked via linking elements **3, 3**, thus allowing handling of the aggregate consisting of multiple individual optical elements **2**. As a result, handling is facilitated during subsequent vapor deposition so as to form mirrored or polarizing surfaces, or during operations that involve analysis, mounting and packaging.

[Claims]

[Claim 1] A resin optical element, characterized by having an assembly of multiple aligned resin optical elements that transmit or reflect incident light, and linking elements that are provided along the direction of alignment of the assembly, wherein the multiple optical elements that constitute the assembly are linked with the help of the linking elements.

[Claim 2] The resin optical element according to claim 1, wherein guide parts for positioning the individual optical elements are formed on the linking elements between adjacent optical elements.

[Claim 3] The resin optical element according to claim 2, wherein the guide parts are depressions or holes.

[Claim 4] The resin optical element according to any of claims 1-3, wherein the optical elements and the linking elements are formed in a single body from the same resin material.
[Claim 5] The resin optical element according to any of claims 1-3, wherein the linking elements are composed of resin elements that are different from the optical elements.
[Claim 6] The resin optical element according to any of claims 1-5, wherein cut-off parts for separating the individual optical elements are provided on the linking elements.
[Claim 7] A method for manufacturing optical elements, characterized by comprising a step wherein resin material is introduced into a mold, and an assembly of optical elements in which individual optical elements are linked via linking elements is formed as a single body, and a step wherein the assembly is transferred after molding, wherein subsequent optical element assemblies are molded using the mold, and the optical element assemblies are continuously formed via the linking elements as a result of repeating this operation.
[Claim 8] A method for manufacturing optical elements, characterized in that an assembly comprising multiple optical elements is formed on a different resin element, the different resin element is transferred after molding, subsequent optical element assemblies are molded using the mold, and the optical element assemblies are continuously formed on a ribbon-form resin element as a result of repeating this operation.

[Detailed Description of the Invention]

[0001]

[Technological Field of the Invention] The present invention relates to a resin optical element such as a lens or mirror, which is used, for example, in optical head devices, and in particular, relates to a resin optical element that is easier to handle during operations such as analysis, packaging and assembly, and to a method for its manufacture.

[0002]

[Prior Art] Optical head devices are provided in various types of disk devices such as CDs (compact disks) and MDs (minidisks). In the above optical head devices, various types of optical elements are used, such as lenses and half mirrors, beam splitters and other mirror components. Light that is incident from a light emitting element such as a laser is reflected by, or passes through, the aforementioned half mirror, beam splitter, or the like, and is conducted to

the aforementioned object lens. At the aforementioned lens, the incident light is focused on a point, and a spot having a constant external diameter is thus formed on the surface of the disk. The reflected light is then conducted to a light receiving element via the aforementioned object lens, half mirror, beam splitter, or the like, and information that has been written on the disk is thereby read.

[0003]

[Problems to be solved by the invention] Conventional optical elements are individually formed by a means such as injection molding. Consequently, optical elements such as half mirrors or beam splitters require the formation of a mirror surface or polarizing surface by means of vapor deposition. However, it has been necessary to position each individual optical element, one at a time, in the aforementioned vapor deposition apparatus in this manufacture process.

[0004] However, the aforementioned optical elements are to be housed in an optical head device, and thus they are often small. In addition, the optical elements have back surfaces, and it is necessary to attach the elements properly while visually identifying the front and back surfaces.

[0005] Consequently, when manufacturing each of the individual small optical elements as descried above, handling of the elements is difficult during subsequent manufacture processes, quality analysis, packaging, assembly and other operations. In particular, because object lenses are round, there is the problem that they are lost when they fall off a table, or the like. Moreover, identifying the front and back surfaces of optical embers tends to be difficult in such cases.

[0006] The object of the present invention is to solve the above conventional problems as a result of offering a resin optical element and a method for manufacturing the same, whereby handling is facilitated during operations such as analysis, packaging and assembly.

[0007]

[Means for solving the problems] The resin optical element of the present invention is characterized by having the form of an assembly of multiple aligned resin optical elements that transmit or reflect incident light, and linking elements that are provided along the direction of alignment of the assembly, wherein the multiple optical elements that constitute the assembly are linked with the help of the linking elements.

[0008] In the present invention, multiple optical elements are linked in a single body with linking elements, and so although each of the optical elements is small, the collective assembly can be

easily handled, which facilitates handling during analysis, packaging and assembly. In addition, in operations whereby optical elements are mounted in a vapor deposition apparatus or the like, it is not necessary to mount each individual optical element, since the mounting operation can be performed with the assembly of multiple optical elements as a single unit, thereby allowing improvement in operational efficiency.

[0009] In addition, a worker performs an operation whereby each individual optical element is separated from the linking elements and the element is then attached to the optical head or other apparatus. Consequently, it is easy to distinguish the front and back surfaces of the individual optical elements by looking at the assembly of the optical elements.

[0010] In the above description, it is preferable to form guide parts for positioning each individual optical element on the linking elements between adjacent optical elements. An arrangement can thus be produced, for example, wherein the aforementioned guide parts comprise depressions or holes.

[0011] In the above arrangement, operations whereby optical elements are attached to optical head devices can be facilitated, and in addition, the optical element can be attached with greater precision.

[0012] In this case, the optical element and the linking elements can be formed as a single body from the same resin material, or alternatively, the aforementioned linking elements and the aforementioned optical elements can be formed from different resin elements.

[0013] Moreover, it is desirable that cut-off parts for separation of the individual optical elements be formed in the aforementioned linking elements, thereby facilitating the cut-off operation.

[0014] The method for manufacturing the resin optical elements in the present invention is characterized by comprising a step wherein resin material is introduced into a mold, and an assembly of optical elements in which individual optical elements are linked via linking elements is formed as a single body, and a step wherein the assembly is transferred after molding, wherein subsequent optical element assemblies are molded using the mold, and the optical element assemblies are continuously formed via the linking elements as a result of repeating this operation.

[0015] In addition, the method for manufacturing the resin optical elements pertaining to the present invention is characterized in that an assembly comprising multiple optical elements is

formed on a different resin element, the different resin element is transferred after molding, subsequent optical element assemblies are molded using the mold, and the optical element assemblies are continuously formed on a ribbon-form resin element as a result of repeating this operation.

[0016] Ordinarily, the number of individual optical elements contained in a single optical element assembly is determined based on the number of cavities in the mold, but in the aforementioned manufacture method, an assembly of optical elements that number more than the number of cavities in the mold can be formed. In addition, it is possible to adjust the number of individual optical elements contained in the assembly of linked optical elements in units corresponding to the number of cavities in the mold.

[0017]

[Embodiments of the invention] The present invention is described below in reference to the figures.

[0018] Figure 1 is a perspective view showing an assembly of mirrors in an embodiment of the optical element pertaining to the present invention. Figure 1A presents a condition in which the optical elements are linked in one direction, and Figure 1B presents a condition in which they are linked in another direction. Figure 2 is a perspective view showing the condition in which the mirrors of Figure 1A are attached.

[0019] In Figure 1A, multiple triangular prism-shaped optical elements **2**, **2**, **2**, . . . are aligned at a constant interval with the inclined surfaces (optical surfaces) **2A** running in the (Y) direction along the length of the figure. In addition, in Figure 1B, the optical elements **2**, **2**, **2**, . . . are aligned at a constant interval with the side surfaces **2b** running in the (Y) direction along the length of the figure.

[0020] The respective optical elements **2** in Figure 1A and 1B are formed from transparent resin material, and multiple metal films or dielectric films are laminated on the aforementioned slanted surfaces **2a** by a means such as vapor deposition. Each optical element **2**, for example, is a completely reflective mirror, and in an optical head or other such device, and the mirror reflects collimated light that is generated by a light emitting element such as a laser, which is then transferred to a disk via a convex lens.

[0021] Linking elements **3**, **3** that extend in the longitudinal direction are provided on the **X1** side and **X2** side of each of the optical elements **2**, and adjacent optical elements **2** are linked via

the aforementioned linking elements **3, 3**. Consequently, the aforementioned multiple optical elements **2** are linked with the help of the aforementioned linking elements **3, 3**, and thus form an assembly **1** of integrated optical elements. V-shaped notched guide parts **3a, 3a** are formed in the aforementioned linking elements **3, 3**.

[0022] The aforementioned linking elements **3, 3** are formed from the same resin material as the resin material used to form the optical elements **2**. Alternatively, a sheet-form metal material can be used as the linking elements **3, 3** instead of a resin material. The assembly **1** of the aforementioned optical elements can be cut at the cut-off line L-L. In this case, when the aforementioned linking elements **3, 3** are formed so that the cut-off part comprising, for example, a V-shaped groove, etc., runs along the aforementioned section line L-L, the individual optical elements 2 can be readily cut apart.

[0023] The optical element **2** shown in Figure 2 is obtained by means of the separation of part of the assembly of the optical elements indicated in Figure 1A. In Figure 2, the designation **4** denotes a base provided on the optical head, etc. Protrusions **4a, 4a** are formed at prescribed locations on the base **4**, and the opposing dimension **W** between the one protrusion **4a** and the other protrusion **4a** is formed so as to be the same as that of guide parts **3a, 3a** formed in the linking elements **3, 3**. Consequently, as a result of latching of the protrusions **4a, 4a** of the base stand **4** together with the aforementioned guide parts **3a, 3a** of the optical element **2**, it is possible to position the optical element on the optical head device at the prescribed location. In this manner, material is not wasted, since the linking element **3** serves to link the individual optical elements **2**, and also serves as an element for fixing an individual optical element **2**.

[0024] Figure 3 is a perspective view showing an optical element assembly of lenses as primary elements used as a second embodiment of the optical element. Figure 3A is a perspective view showing an example of the assembly of optical elements, and Figure 3B is a perspective view showing another example of an assembly of optical elements. Figure 4 is a perspective view showing an assembly of optical elements with flat mirrors as the primary elements used as a third embodiment. Figure 5 is a perspective view showing an assembly of optical elements with prisms as the primary elements used as a fourth embodiment.

[0025] In Figure 3A, the individual lenses **12, 12, 12, . . .** functioning as the optical elements are linked via a pair of linking elements **3, 3**, thus forming an optical element assembly **10**

comprising multiple lenses **12**. In Figure 3B, individual lenses **12, 12, 12**, . . . are linked via a single linking element **3**, thus forming an assembly **11** comprising optical elements.

[0026] In Figure 4, flat mirrors, **22, 22, 22**, . . . used as optical elements are linked with the help of a pair of linking elements **3, 3**, thus forming an assembly **21** of optical elements comprising multiple flat mirrors **22**. In Figure 5, triangular prisms **32, 32, 32**, . . . functioning as optical elements are linked with the help of a pair of linking elements **3, 3**, thus forming an assembly **31** of optical embers comprising triangular prisms **32**.

[0027] With the assemblies **10, 11, 21** and **31** of the optical elements indicated in Figures 3-5, the individual optical elements **12, 22** and **32** are each cut along the cut-off line L-L that crosses the respective linking elements **3**, thus allowing separation into individual optical elements. In addition, on both sides of the aforementioned cut-off line L-L, guide parts **3a, 3a** are formed which consist of through holes. Thus, the individual optical elements **12, 22** and **32** can be easily positioned and fixed at a prescribed location on an optical head or other device by means of fitting of the aforementioned guide parts **3a, 3a** onto protrusions such as bases that have been formed as indicated in Figure 2.

[0028] In the manufacture of the optical elements, as a result of forming the respective optical elements **2, 12, 22** and **32** as assemblies **1, 10, 11, 21** and **31** of optical elements that are linked via linking elements **3**, it is possible to carry out analysis and packaging of the optical elements using each of the assemblies **1, 10, 11, 21** and **31**, and consequently, handling is facilitated in comparison with cases in which individual optical elements **2, 12, 22** and **32** are handled.

[0029] In addition, at an assembly facility where the optical element assemblies **1, 10, 11, 21** and **31** are received, an operation can be carried out in which the operator performs the assembly process while cutting off the individual optical elements **2, 12, 22** and **32**, thus preventing loss of optical elements. In addition, by means of viewing the optical element assemblies **1, 10, 11, 21** and **31**, it is possible to distinguish the front and back surfaces of the optical elements at a glance, so that errors in attaching the optical elements **2, 12, 22** and **32** can be prevented.

[0030] The method for manufacturing the aforementioned optical element assemblies is discussed below. Figure 6 is a process diagram showing the method for manufacturing optical elements, where Figure 6A presents a first step, Figure 6B presents a second step, and Figure 6C presents a step in which the optical elements are linked. In this manufacture method shown in Figures 6A-C, a mold **41** for forming the optical elements **2**, an extruder **42** for injecting melted

resin material into the aforementioned mold **41**, and a transfer means **43** are provided. The aforementioned mold **41** is composed of a pair of molds consisting of an upper mold **41A** and a lower mold **41B**.

[0031] Multiple (three in Figure 6) cavities **41a**, **41a**, **41a** are provided on the inside of the aforementioned mold **41A** aligned longitudinally at a determinate spacing. An injection hole **41c** and a runner **41b** that conducts the melted resin into the aforementioned multiple cavities **41a**, **41a**, **41a** are formed in the aforementioned mold **41A**. The aforementioned extruder **42** is, for example, a screw extruder. In the barrel of the extruder **42**, the resin material is melted while being kneaded, and the melted resin is extruded into the injection hole **41c** of the aforementioned mold **41A**. An example of the transport means **43** is a belt conveyor in which a belt **43a** is caused to move in intermittent fashion in a constant direction (direction **Y1** indicated in Figure 5).

[0032] The manufacture method in this embodiment involves the use of an insert molding for the base. Specifically, in the first step shown in Figure 6A, the lower mold **41B** is placed on the belt **43a** of the transport means **43**, and linking elements **3**, **3** composed of resin material are aligned in the aforementioned depression of this lower mold **41B** so that they are parallel with each other in the longitudinal direction (Y). In the second step shown in Figure 6B, the upper mold **41A** is placed on the lower mold **41B**, and the linking elements **3**, **3** are placed so that they are sandwiched between the upper mold **41A** and lower mold **41B**. Then, the tip of the nozzle of the extruder **42** is inserted into the aforementioned injection hole **41c**, and the melted resin is injected into the respective cavities **41a** through the aforementioned runners **41b**.

[0033] Next, after a determinate period of time has passed, the upper mold **41A** is lifted upwards in the figure, and an assembly **1** of optical elements in which linking elements **3** and multiple optical elements **2** are integrated is formed on the lower mold **41B**.

[0034] In addition, as shown in Figure 6C, upon completion of the aforementioned second step, the transport means **43** can move a determinate distance in the upstream direction (Y1), and then the first and second steps may be repeated in a continuous manner. In this case, it is possible to form an assembly **1** of new optical elements adjacent to the assembly **1** of optical elements molded previously in the first and second steps on the aforementioned optical elements **3**, **3**. Consequently, depending on the length of the linking elements **3**, **3**, the number of individual optical elements **2** to be formed can be adjusted in units of the optical element assembly **1**.

[0035] The aforementioned mold **41** may also integrate the optical elements **2** and linking elements **3**. In this case, it is preferable to form the guide part **3a** or the aforementioned cut-off part in the cavity corresponding to the linking element **3**. By this means, the guide part **3a** and the cut-off part can be integrated in the linking element **3**.

[0036]

[Effect of the invention] According to the present invention described above, it is possible to handle individual optical elements as a single collective assembly of optical elements, so that handling is facilitated during operations such as analysis, packaging and assembly.

[0037] By means of providing guide parts on the linking elements, positioning of the optical elements is facilitated, and the optical elements can be fixed with high precision.

[Brief description of the figures]

[Figure 1] Perspective view showing an assembly of mirrors used as an embodiment of the optical element pertaining to the present invention. Figure 1A presents a condition in which the optical elements are linked in one direction, and Figure 1B presents a condition in which they are linked in another direction.

[Figure 2] Perspective view showing attachment of the mirrors from Figure 1A.

[Figure 3] Perspective view showing an optical element assembly with lenses as primary elements, used as a second embodiment of the optical element. Figure 3**A** is a perspective view showing an example of the assembly of optical elements, and Figure 3B is a perspective view showing another example of an assembly of optical elements.

[Figure 4] Perspective view showing an optical element assembly with flat mirrors as the primary elements used as a third embodiment.

[Figure 5] Perspective view showing an optical element assembly with prisms as the primary elements used as a fourth embodiment.

[Figure 6] Process diagram showing the manufacture method for optical elements, where Figure 6A presents the first step, Figure 6B presents the second step, and Figure 6C presents the step in which the optical elements a linked.

[Key:]

1, 10, 11, 21, 31: Assembly of optical elements

2, 12, 22, 32: Optical elements

3: Connecting element

3a: Guide part

4a: Protrusion

41: Mold

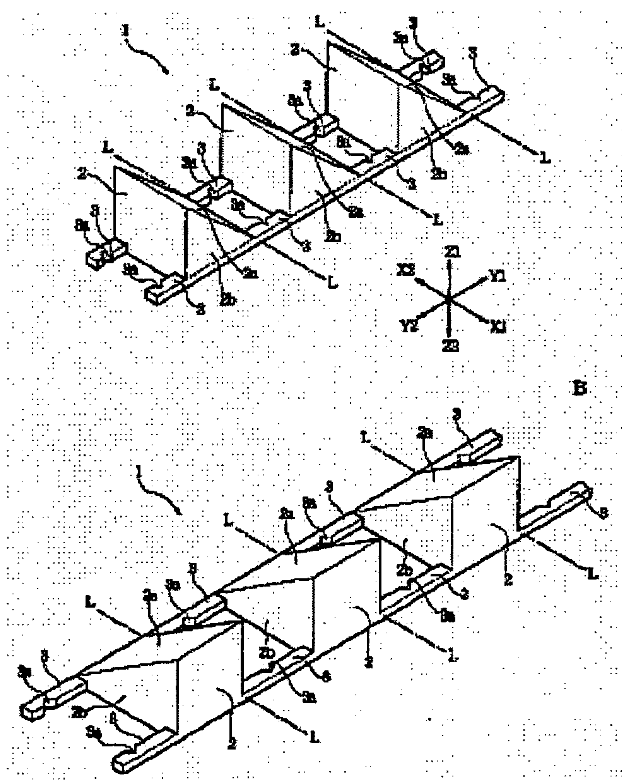
41a: Cavity

42: Extruder

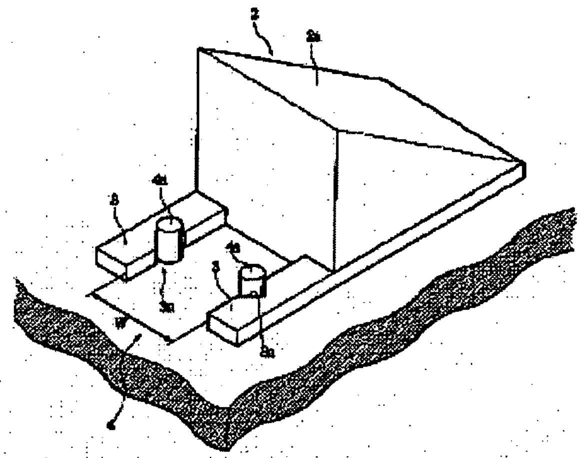
43: Transport means

L: Cut-off line

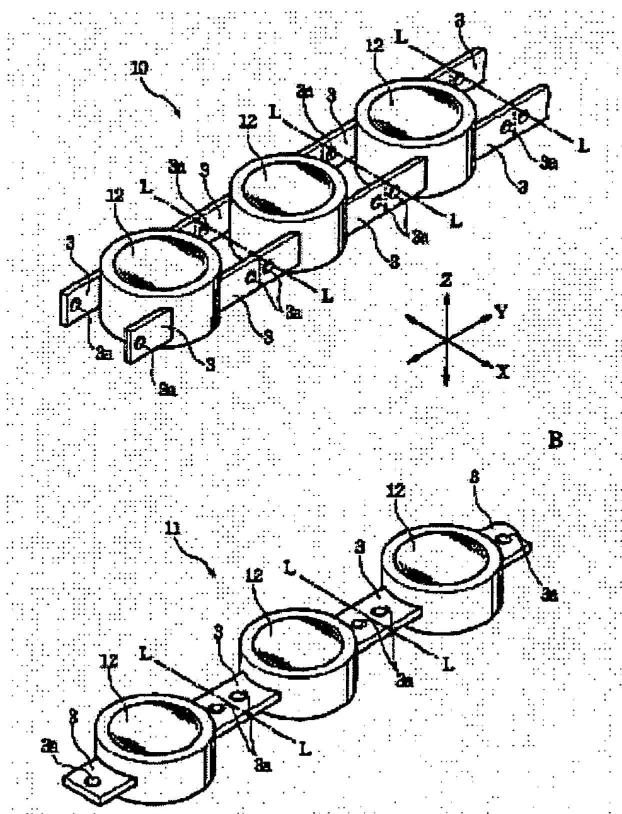
[Figure 1]



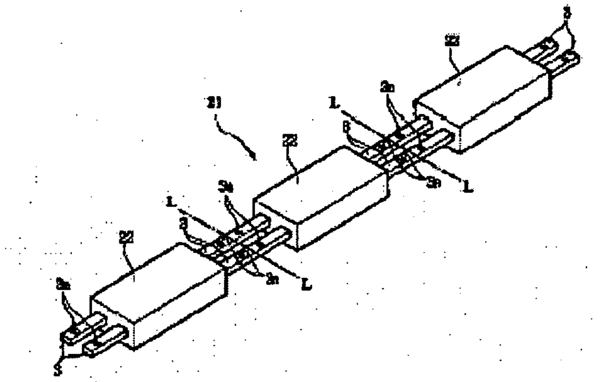
[Figure 2]



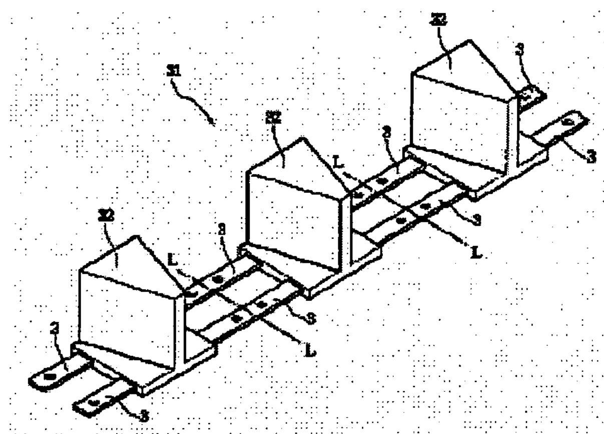
[Figure 3]



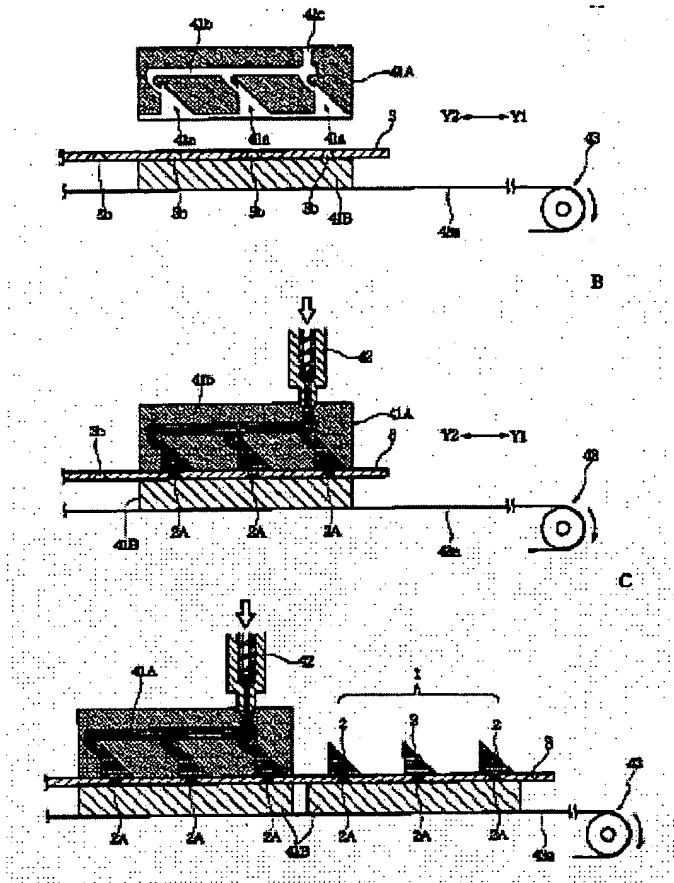
[Figure 4]



[Figure 5]



[Figure 6]



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